Appendix A1a

Methods for Estimating Regional Sacramento/Delta Surface Water Supply for Agricultural and Municipal Use

A1a.1 Introduction

This Staff Report analyzes the potential environmental and economic effects that may result from implementation of proposed changes to the Bay-Delta Plan. Changes in flow requirements could cause changes in hydrology and water supply within the Sacramento/Delta as well as in regions that receive water from the Sacramento/Delta. The Sacramento Water Allocation Model (SacWAM) is used to simulate changes in hydrology and water supply that could result from changes in flow and other water quality objectives. The SacWAM Model Documentation (^SacWAM 2023) provides the methods and assumptions used to develop the SacWAM model. Appendix A1 provides additional assumptions used for the analyses in this report and provides the results of the SacWAM simulations in tables and figures for parameters such as reservoir operations and water supply at SacWAM demand units, and includes modeled changes in CVP and SWP operations and North of Delta and South of Delta contractor deliveries.

The Staff Report uses multiple modeling tools in addition to SacWAM to evaluate the potential effects of proposed changes to the Bay-Delta Plan. SacWAM results, such as river flows, reservoir levels, local runoff, diversions, exports, and other water supplies, are used as inputs to these modeling tools. This sub-appendix provides an overview of the methods for translating SacWAM information into Sacramento/Delta supply estimates for agricultural and urban use in the San Francisco Bay, San Joaquin Valley, Central Coast, and Southern California study regions. The detailed methods are provided in Attachment A1a1, *California Sub-Regional Agricultural Analysis*. Agricultural supply estimates are subtracted from total Sacramento/Delta supply estimates to obtain municipal supply estimates.

Linkages between SacWAM results and models for other resources are discussed in the appendices for those particular models. For example, linkages between SacWAM results and the DSM2 model of the Delta are covered in Appendix A2, linkages between SacWAM results and hydropower calculations are covered in Appendix A5, and linkages between SacWAM results and water temperature modeling are covered in Appendix A6.

A1a.2 Relationships between SacWAM Results and Study Regions

Effects that could result from actions taken in response to changes in Sacramento/Delta hydrology and surface water supply could occur within a seven-region study area (Figure A1a-1). This includes the Sacramento/Delta and areas that receive Sacramento/Delta supplies, such as the SWP and CVP service areas, and other non-Project service areas (e.g., East Bay Municipal Utility District service area in the San Francisco Bay Area). To provide for a consistent and organized discussion, the effects

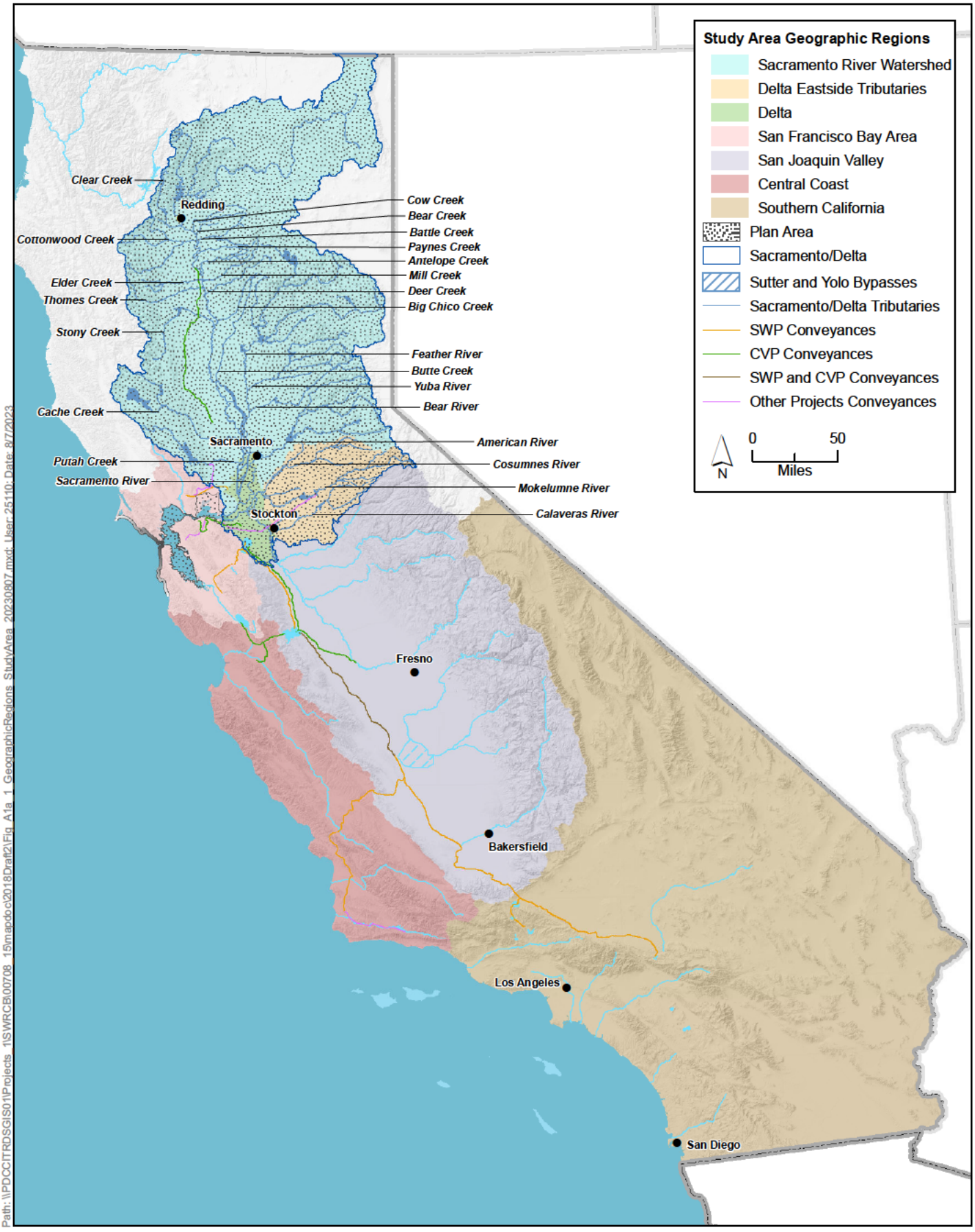

Figure A1a-1
Study Area Geographic Regions

analysis for agriculture and municipal water supply is organized into the seven regions of the study area.

Changes in hydrology and water supply are anticipated to affect both agricultural irrigators and municipal water providers in the study area. The process for determining the effects requires linking several analytical models. The models are connected by using model results from one model as input to another, requiring proper mapping from one to the other and into study regions. The mapping of SacWAM results into the seven study regions is shown in Figure A1a-2.

The SacWAM model provides detailed output of monthly quantities of Sacramento/Delta surface water supplies for a 94-year simulation, which is based on water year 1922 to water year 2015 hydrologic conditions. Monthly output values for the time series are combined into annual averages for use in both the agricultural and municipal effects analyses. Modeling results are compared to baseline condition modeling results to help inform the determination of potential environmental impacts.

Information from a variety of sources was used to estimate Sacramento/Delta supplies for agricultural and municipal use for each study region. For water supplied to CVP contractors, SacWAM provides separate demand nodes for agricultural and urban uses that are based on CVP contract information published by the U. S. Bureau of Reclamation (Reclamation 2016). For water supplied to SWP contractors and non-project users north of the Delta, the type of use was categorized by California Department of Water Resources (DWR) land use data (DWR 1994a-b, 1995a-b, 1996, 1997b, 1998a-c, 1999a-b, 2000a). For water supplied to SWP contractors south of the Delta, the type of use was categorized using DWR published information (DWR 2007) and review of local water management plans.

Within the Sacramento River Watershed, Delta, and Delta Eastside Tributaries regions, the surface water deliveries estimated by SacWAM are used directly in the respective region's agricultural and municipal analysis because SacWAM provides separate agricultural and municipal supply results in these regions. In contrast, the quantity of Sacramento/Delta supply that is exported to the San Joaquin Valley, San Francisco Bay Area, Central Coast, and Southern California regions is estimated within SacWAM but the output is in aggregate form that requires additional data processing before it can be used in the regional agricultural and municipal analyses. For example, SacWAM provides combined agricultural and municipal Sacramento/Delta water supply results for SWP deliveries for parts of the lower San Joaquin Valley and the Central Coast. The mapping of SacWAM results to the individual study regions and smaller subareas within each of the receiving regions relies on a separate process that is based on a more detailed evaluation of SWP and CVP contracts and deliveries. This more detailed mapping of water supply to subregions includes review of local water management plans to develop assumptions regarding the distribution of Sacramento/Delta supply to municipalities and commercial agriculture, which allows changes in agricultural water deliveries and their effects on crop acreage and crop mix to be estimated. Changes in municipal water deliveries are estimated by subtracting agricultural water deliveries from total deliveries. This process is described in more detail in Attachment A1a1, *California Sub-Regional Agricultural Analysis.*

The relationships between SacWAM demand units, types of water supplies, and geographic location in the study region is illustrated in Figure A1a-2, with details in Table A1a-1. Figure A1a-2 superimposes "locator zones" over the study regions which, when combined with Table A1a-1, shows how SacWAM demand units overlay the study regions. Table A1a-1 is organized by locator

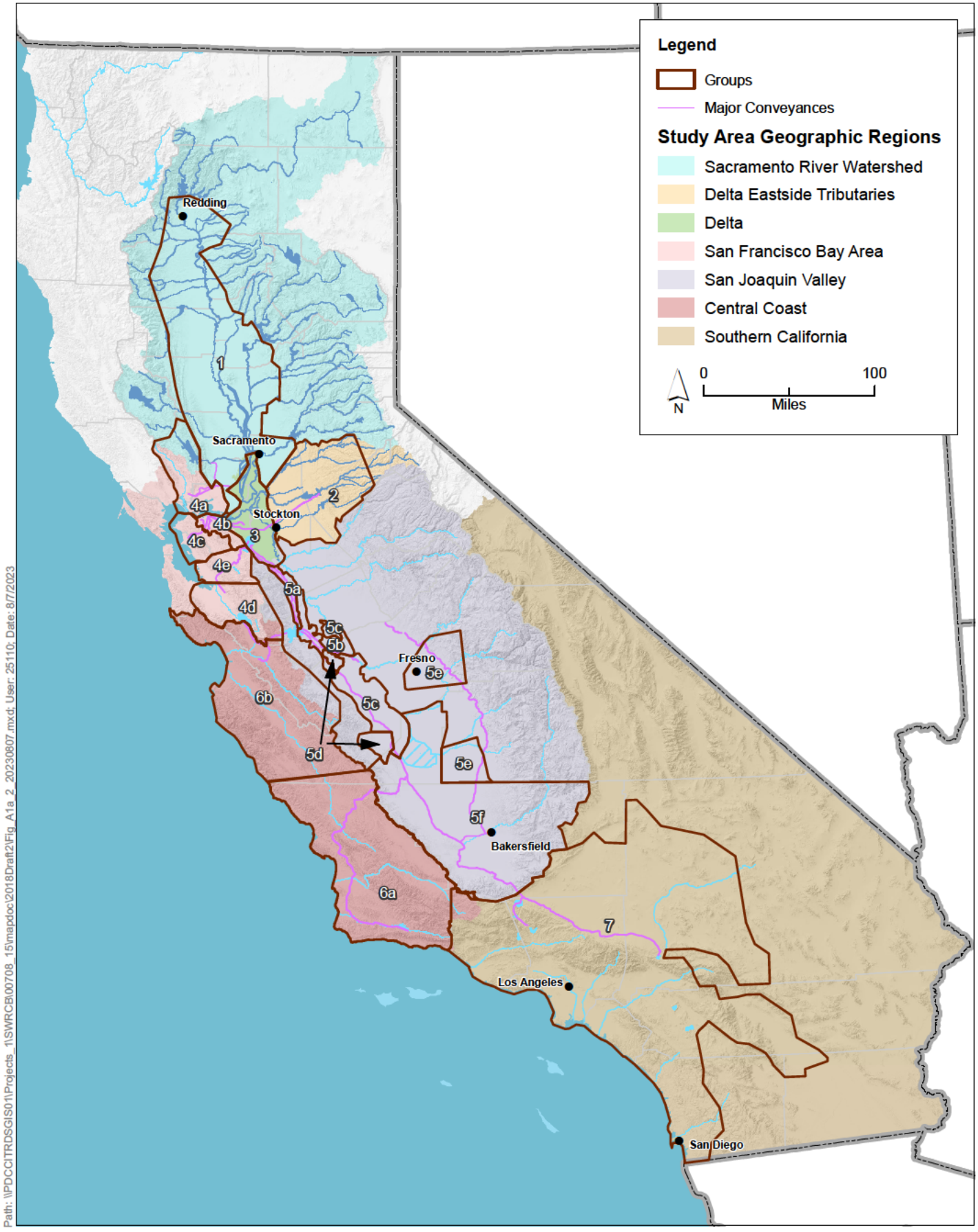

Figure A1a-2
Locator Map Zones of the Study Area

zones that correspond to regions outlined in Figure A1a-2 that provide a general spatial reference for the locations of the demand units.

Locator Zones 1contain both urban and agricultural use that are separate outputs from SacWAM, represented by U_XX and A_XX demand node structures, respectively. Locator Zone 1 contains water deliveries from the Sacramento River and its tributaries. Locator Zone 2 represents direct diversions in the Delta eastside tributaries. Locator Zone 3 is the Delta and includes both CVP deliveries and direct diversions.

Locator Zones 4a through 4e, in the San Francisco Bay Area, are represented as five subzones. The subzones correspond to delivery canals and adjacent areas, all of which are primarily municipal deliveries to wholesalers. One exception is in Locator Zone 4a, which contains the agricultural delivery to the Solano Project. Some wholesalers ultimately deliver a portion of their Sacramento/Delta supply to irrigation customers. For example, Locator Zone 4e includes South Bay Aqueduct deliveries. Local water management plans indicate that a portion of the Sacramento/Delta supply to Alameda County Flood Control and Water Conservation District (Zone 7) is delivered to agricultural customers. Attachment A1a1, *California Sub-Regional Agricultural Analysis*, provides the methods used for estimating the agricultural supply portion of the South Bay Aqueduct deliveries. CVP deliveries to the San Felipe Division for municipal use are in Locator Zone 4d.

Locator Zones 5a through 5g can all be found in the northern San Joaquin Valley. Locator Zones 5a through 5g are CVP agricultural deliveries distinguished by CVP canal and adjacent use: Upper Delta-Mendota Canal (DMC), Lower DMC, and Mendota Pool; and California Aqueduct SWP agricultural deliveries. Locator Zone 5d contains both urban and agricultural use associated with the CVP San Luis Canal, which are separate outputs from SacWAM. Locator Zone 5f is associated with CVP Cross Valley Canal agricultural use.

Locator Zones 5g and 6b cover the southern San Joaquin Valley and the Central Coast, reflective of SacWAM SWP export deliveries to the area. The San Joaquin Valley portion, Locator Zone 5g, represents SWP deliveries to Tulare County wholesalers. The Central Coast portion, Locator Zone 6b, represents SWP deliveries via the Coastal Aqueduct to San Luis Obispo and Santa Barbara Counties. Attachment A1a1, *California Sub-Regional Agricultural Analysis*, provides the methods used for estimating the agricultural supply portions of these deliveries.

Locator Zone 6a is associated with CVP agricultural deliveries to the San Felipe Division in the northern portion of the Central Coast region.

Locator Zone 7 represents SWP deliveries to Southern California. Attachment A1a1, *California Sub-Regional Agricultural Analysis*, provides the methods used for estimating the agricultural supply portions of these deliveries.

Table A1a-1. Legend for Locator Map

Study Region	Map Locator Group	Municipal Supply	Irrigation Supply	Municipal and Irrigation Supply	Example Water Users
Sacramento River Watershed	1	WBAs, U_02 through U_26			CVP Sacramento River settlement contracts, CVP water service contracts, SWP long-term contracts, Feather River settlements, Redding region, Sacramento region, portions of Placer County Water Agency (PCWA), Yolo County diversions, small communities
	1		WBAs, A_02 through A_26		CVP Sacramento River settlement contracts, CVP water service contracts, SWP long-term contracts, Feather River settlements, Yolo County diversions, South Sutter Irrigation District (ID), Camp Far West ID, Nevada ID (portion), PCWA (portion), Solano Project (portion), Orland Project (portion), individual water right holders
Delta Eastside Tributaries	2	U_AMADR_NU			Amador County Water Agency
	2	U_JLIND_NU			Calaveras County Water District (WD)
	2	U_CaCWD_NU U_CPU_NUD			Calaveras County WD and Calaveras Public Utilities District (PUD)
	2	U_60N_NU2 U_60S_NU1			Lodi, Galt, Stockton, Rancho Murieta, Rancho Seco, small communities
	2		A_60N A_60S		Jackson Valley ID, North San Joaquin Water Conservation District (WCD), Woodbridge ID, Stockton East WD, Central San Joaquin WCD, riparian and non-district diversions
Delta	3	U_ANTOC_NU			Antioch
	3	CVP Upper DMC Urban Demands			City of Tracy
	3		A_50_NA1 through A_50_NA7		North Delta Water Agency (WA) Central Delta WA South Delta WA

Study Region	Map Locator Group	Municipal Supply	Irrigation Supply	Municipal and Irrigation Supply	Example Water Users
					Byron Bethany ID
	3		CVP Upper Delta-Mendota Canal (DMC) Ag Demands (portions)		Byron-Bethany ID Banta-Carbona ID West Side ID
San Francisco Bay Area	4a	U_NAPA_PU U_BNCIA_PU U_FRFLD U_TRAFB_PU U_VLLJO_PU U_20_25_PU			North Bay Aqueduct: Napa County Flood Control and Water Control District (FC&WCD), Solano County, Vallejo, Benicia, Fairfield, Vacaville, Travis Air Force Base
	4a		A_SIDSH_NA		Solano ID, Solano Project (portion)
	4b	U_CCWD_PU			Contra Costa WD
	4c	U_EBMUD_NU			East Bay Municipal Utility District: Berkeley, Oakland, Richmond, Walnut Creek
	4d	CVP San Felipe Urban			Santa Clara Valley WD San Benito County WD
	4e			SWP SBA Table A SWP SBA Article 21	Alameda County FC&WCD (Zone 7) Alameda County WD Santa Clara Valley WD
San Joaquin Valley	5a		CVP Upper DMC Ag Demands (portions)		Del Puerto WD Patterson ID West Stanislaus ID
	5a		CVP Upper DMC Water Rights		Patterson ID
	5a		SWP San Joaquin		Oak Flat WD
	5b		CVP Lower DMC Exchange Demands		Central California ID (north)
	5b		CVP Lower DMC Ag Demands		San Luis WD (north) Eagle Field WD

Study Region	Map Locator Group	Municipal Supply	Irrigation Supply	Municipal and Irrigation Supply	Example Water Users
					Mercy Springs WD Oro Loma WD
	5c		CVP Mendota Pool Exchange Demands		Central California ID Columbia Canal Company Firebaugh Canal WD San Luis Canal Company
	5c		CVP Mendota Pool Ag Demands		James ID Laguna WD Reclamation District 1606 Terra Linda Farms Tranquility ID Tranquility PUD Westlands WD (Laguna WD assignment) Westlands WD (Oro Lomo WD assignment)
	5c		CVP Mendota Pool Water Rights Demands		Fresno Slough WD James ID Reclamation District 1606 Terra Linda Farms Tranquility ID Tranquility PUD
	5d	CVP San Luis Canal Urban Demands			Avenal Coalinga Huron
	5d		CVP San Luis Canal Ag Demands		Pacheco WD Panoche WD San Luis WD (south) Westlands WD

Study Region	Map Locator Group	Municipal Supply	Irrigation Supply	Municipal and Irrigation Supply	Example Water Users
	5f		Cross Valley Canal		County of Fresno Hills Valley ID Kern-Tulare WD Lower Tule River ID Pixley ID Kern-Tulare WD Tri-Valley WD
	5g			SWP Central Coast Tulare Table A (portions) SWP Central Coast Tulare Article 21 (portions)	Kings County Dudley Ridge WD Empire West Side ID Kern County WA Tulare Lake Basin WSD
Central Coast	6a		CVP San Felipe Ag		Santa Clara WD San Benito WD
	6b			SWP Central Coast Tulare Table A (portions) SWP Central Coast Tulare Article 21 (portions)	San Luis Obispo County FC&WCD Santa Barbara County FC&WCD
Southern California	7			SWP South Coast Table A SWP South Coast Article 21	Antelope Valley-East Kern WA Castaic Lake WA Coachella Valley WD Crestline-Lake Arrowhead WA Desert WA Littlerock Creek ID Mojave WA Metropolitan WD of Southern California Palmdale WD San Bernardino Valley Municipal Water District (MWD)

Study Region	Map Locator Group	Municipal Supply	Irrigation Supply	Municipal and Irrigation Supply	Example Water Users
					San Gabriel Valley MWD San Gorgonio Pass WA Ventura County Watershed Protection District

A1a.3 References Cited

A1a.3.1 Common References

^SacWAM 2023: State Water Resources Control Board (SWRCB). 2023. *Sacramento Water Allocation Model (SacWAM) Documentation*.

A1a.3.2 Section References

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Attachment A1a1

California Subregional Agricultural Analysis (CASRAA), Methods for Estimating Effects on Agriculture in the San Francisco Bay Area, Central Coast, and Southern California Regions, and in the Upper Watersheds

Attachment A1a1
California Subregional Agricultural Analysis (CASRAA)

Methods for Estimating Effects on Agriculture in the San Francisco Bay Area, Central Coast, and Southern California Regions, and in the Upper Watersheds

September 2023

Geographic Scope:

The California Subregional Agricultural Analysis (CASRAA) is used to estimate the portion of Sacramento/Delta supply that is used for agriculture, and to analyze the effects of changes in water supply on agriculture in the Upper Watersheds and the San Francisco Bay Area, Central Coast, and Southern California Regions. These are locations that are outside of the geographic domain of the Statewide Agricultural Production (SWAP) model.

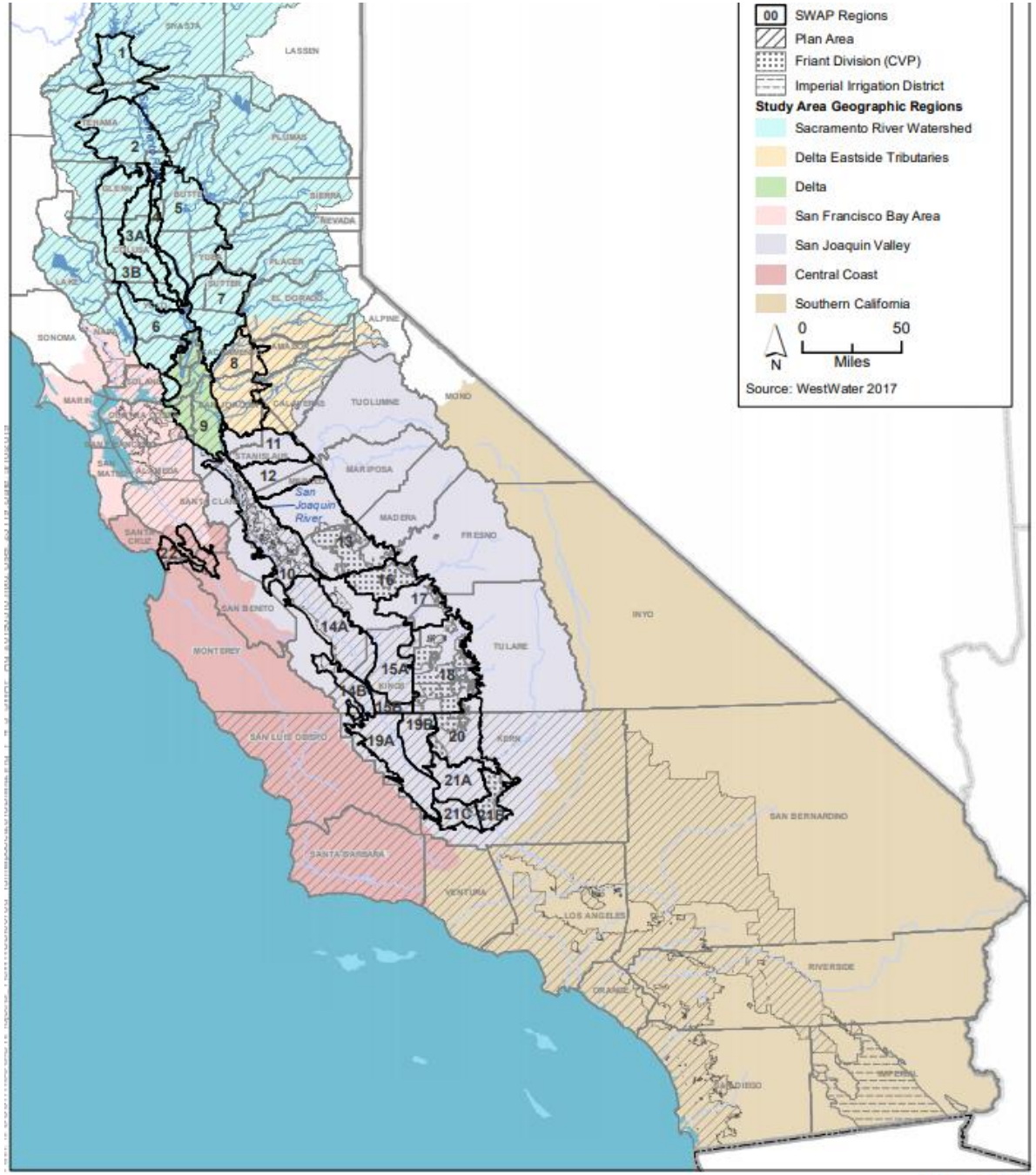


Figure 7.4-5
Statewide Agricultural Production (SWAP) Regions in the Study Area

Features of SWAP and CASRAA

FEATURES/ATTRIBUTES	SWAP	CASRAA
Utilizes DWR's Detailed Analysis Units (DAUs) for geographic extent of cropping pattern	X	X
Utilizes baseline cropping patterns from 2010 DWR land use survey data	X	X
Incorporates site-specific, regional crop water requirements in cropping pattern	X	X
Incorporates available water supply in cropping pattern analysis	X	X
Substitutes water supply source under reduced supply conditions	X	
Considers contemporary prices, yields, and cost of production for representative crops	X	X
Utilizes UC Cooperative Extension crop enterprise budgets		X
Incorporates profit-maximizing behavior of farmers within limits of resource constraints	X	X
Crop substitution within optimization	X	
Market constraints on high-profit crops	X	X
Utilizes land fallowing as cost-effective response to resource limits	X	X

CASRAA Approach Objectives: Estimate the effects of changes in Sacramento/Delta supply on agriculture in agricultural production regions that are not included in the SWAP model. Apply an analysis approach that is consistent with SWAP.

Analytical Approach:	Step 1 Develop fractioning that can be applied to total Sacramento/Delta supply delivery results obtained from SacWAM	Step 2 Apply fractions to SacWAM results to estimate agricultural and municipal supplies for baseline and flow scenarios	Step 3 Representative Crop Types, Crop Applied Water Requirements, and Baseline Crop Acreage	Step 4 Estimate Reduction in Crop Acres	Step 5: Apply UC Crop Budgets to Estimate Reduction in Gross and Net Crop Revenues
Source Information:	Local Water Management Plans (see "References Consulted")	SacWAM Results and Results of Step 1	DWR 2010 land use survey information	Results of Steps 2 and 3 and crop optimization	Results of Step 4
San Francisco Bay Area	X	X	X	X	
Central Coast	X	X	X	X	
Southern California	X	X	X	X	
Upper Watersheds	Qualitative analysis	Qualitative analysis	X	Qualitative analysis	Qualitative analysis

Section 1: San Francisco Bay Area

Sacramento/Delta Water Supply to San Francisco Bay Area

- Water that is exported from the Sacramento/Delta to San Francisco Bay Area is accounted for in SacWAM as by demand sites representing deliveries through the North Bay Aqueduct and South Bay Aqueduct; CVP San Felipe Urban demands; and the agricultural demand unit for Putah South Canal (A_SIDSH_NA).
- Categories of water deliveries to the San Francisco Bay Area:
  - Direct (non-SWP/CVP Project) Sac/Delta water rights (Antioch, CCWD, EBMUD)
  - Lake Berryessa/Reclamation Solano Project – Putah Creek South Canal
  - SWP contracts, through North Bay Aqueduct

    Solano County Water Agency: Benicia, CSPS-Solano, Fairfield, Suisun City, Travis AFB, Vallejo, Vacaville

    Napa County Flood Control and Water Conservation District: American Canyon, Calistoga, Napa, St. Helena
  - SWP contracts, through South Bay Aqueduct

    Alameda County FC&WD (Zone 7), Alameda County WD, Santa Clara Valley WD –*M&I only*
  - DWR Settlement agreements (Benicia, Fairfield)
  - CVP contracts, through Pacheco Conduit

    Santa Clara Valley WD and San Benito County WD M&I supplies

Analysis of San Francisco Bay Area Agricultural Water Use

Reviewed UWMPs to determine which entities deliver water for agricultural uses. All water providers deliver water primarily, or exclusively, for municipal purposes. One SWP contractor (Zone 7) delivers water to agricultural producers. How much Sac/Delta water is relied upon for agricultural irrigation was estimated by applying some reasonable assumptions.

Results of UWMP review:

North Bay Aqueduct:

Solano County Water Agency: agency serves municipal and agricultural providers in Solano County, but SWP serves only municipal uses.

Napa County FC&WCD: provides interruptible irrigation service to 28 wineries through blended sources. Supply sources far exceed demand and will continue to even with a small reduction in SWP.

Putah South Canal: SacWAM estimates of the reductions in agricultural deliveries to Solano I.D.

EBMUD: Serves no commercial agriculture.

CCWD: Serves a small agricultural operation with treated wastewater only.

South Bay Aqueduct:

SCVWD: SWP water serves only M&I uses. Local growers in SCVWD service area pump groundwater, about 26K AFY, but this is expected to decline as ag lands are converted to urban use.

ACWD: provides no water to commercial agriculture.

Zone 7: provides mostly urban water, but also 5,600 AF to commercial agriculture. This is expected to increase to 7,800 AF by 2030. Ag demand is for high valued crops: wine grapes, olives, pistachios. Zone 7 relies upon groundwater banking agreements with Semitropic and Cawelo WD, and has offset SWP reductions through substitutions.

Findings and required analyses:

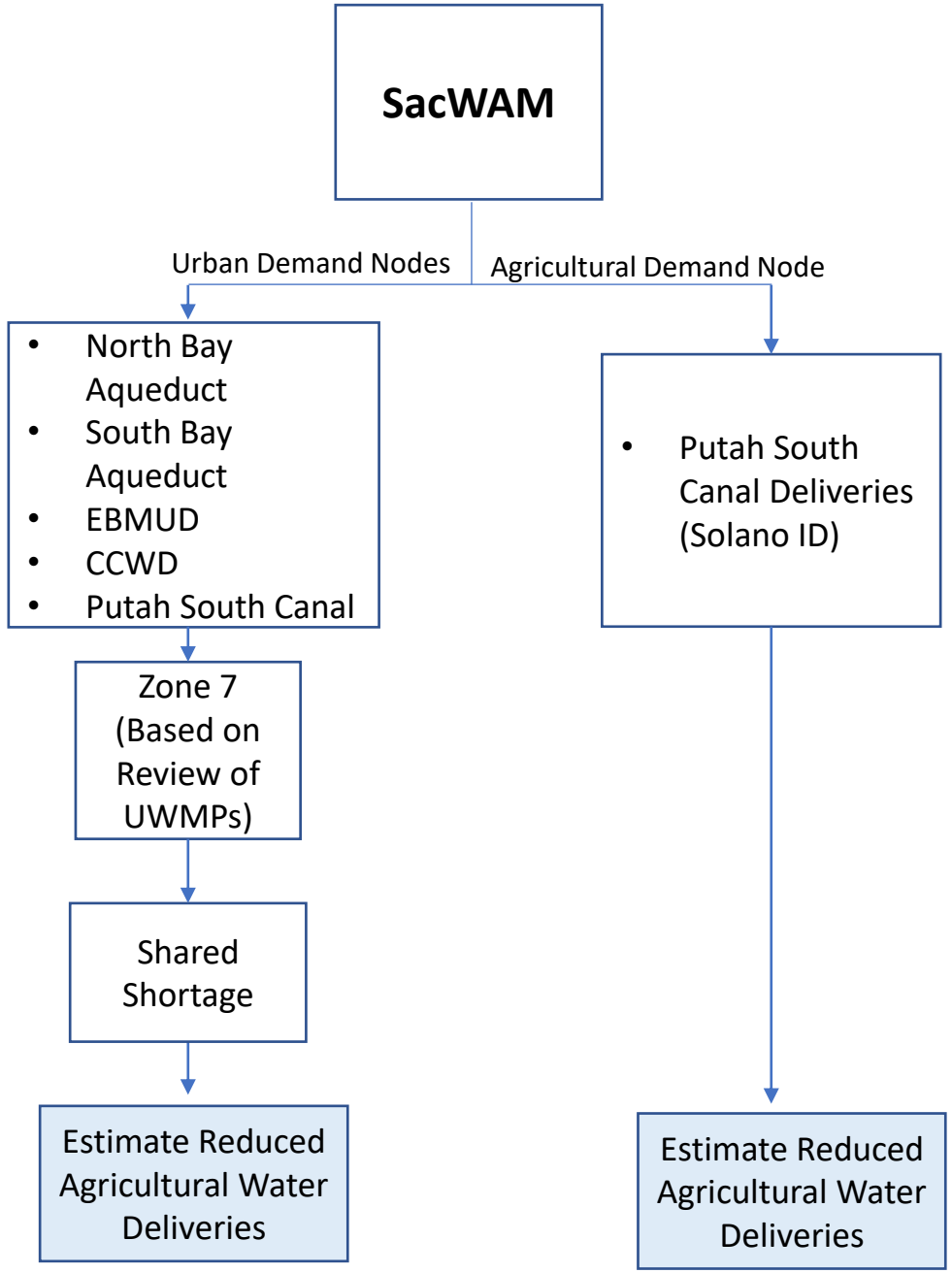
- CASRAA analysis applied to Zone 7
- CASRAA analysis applied to Putah Creek South Canal agricultural water by Solano Irrigation District

San Francisco Bay Area

Step 1: SacWAM output is apportioned to water users in the Bay Area based on contracts and water rights.

Step 2: Review UWMPs to identify any estimated 2030 agricultural demands that potentially receive water from the Sac/Delta.

Step 3: Estimate the reduction in agricultural water supply for each flow scenario assuming a shared shortage between agricultural and M&I water users.



San Francisco Bay Area – Putah South Canal

Estimated Reduced Agricultural Water Deliveries:

Putah South Canal agricultural water deliveries.

Putah South Canal Ag Deliveries as Estimated by SacWAM (AF) – Demand Unit A_SIDSH_NA

Scenario	Avg	Dry
Baseline	27,899	29,201
35	22,331	21,095
45	19,893	18,437
55	16,485	17,055
65	13,905	13,736
75	10,570	10,979

San Francisco Bay Area – Zone 7

Total SacWAM SWP deliveries to South Bay Aqueduct Demand Site

Zone 7's proportion of the total Table A contract amounts among South Bay Aqueduct users (**36.21%**) and Article 21 (**16.67%**)

Total volumes in SWP deliveries to Zone 7 were obtained from SacWAM output using Zone 7's share of SWP deliveries to South Bay Aqueduct, by Table A and Article 21 volumes.

Zone 7's projected 2030 SWP agricultural water demand (7,800 AF) was obtained from Zone 7's 2020 UWMP. Calculated share of total baseline deliveries (Table A plus Article 21).

SWP SBA Total Deliveries (AF) as Estimated by SacWAM for South Bay Aqueduct, Table A and Article 21

Scenario	Avg	Dry
Baseline	140,916	104,537
35	134,969	96,757
45	117,803	75,837
55	101,266	61,418
65	93,790	54,901
75	89,627	51,387

Scenario	Avg	Dry
Baseline	535	273
35	694	293
45	1,106	513
55	1,045	304
65	995	211
75	662	97

Zone 7 share of SBA Table A =36.21%

Zone 7 share of SBA Article 21 =16.67%

Zone 7 Total Deliveries (AF)

Scenario	Avg	Dry
Baseline	51,031	37,857
35	48,872	35,036
45	42,656	27,461
55	36,669	22,240
65	33,961	19,880
75	32,454	18,607

Scenario	Avg	Dry
Baseline	89	45
35	116	49
45	184	85
55	174	51
65	166	35
75	110	16

Percentage Share of Zone 7 to Agriculture

7,800 AF of 51,120 AF = 15.26%

San Francisco Bay Area – Zone 7, Continued

Zone 7 ag deliveries by baseline and flow scenario (sum of Table A and Article 21 from previous slide)

Scenario	Avg	Dry
Baseline	51,120	37,902
35	48,988	35,085
45	42,841	27,546
55	36,843	22,290
65	34,127	19,915
75	32,564	18,623

Zone 7's ag share of total deliveries (previous slide).

15.26 percent

Reduction in Zone 7 Ag Deliveries (AF)

Estimated Zone 7 reduction in agricultural water deliveries. Shortage shared among all customers multiplies the percentage change in water deliveries to Zone 7 by the 2030 agricultural water demand (7,800 AF) to obtain the change in agricultural water supplies from the Sac/Delta.

UF Scenario	Avg	Dry
35	330	436
45	1,283	1,605
55	2,213	2,420
65	2,634	2,789
75	2,877	2,989

Crops and Crop Water Requirements

- Representative Crops
  - Putah South Canal:
    - Alfalfa
    - Pasture
  - Zone 7:
    - Vines
    - Deciduous Orchards
- Applied Water Requirements

	Acre-Feet / Acre
Alfalfa	3.05
Pasture	3.21
Vines	1.05
Pistachios	2.73

Representative crops were selected for the two locations based upon their likelihood to be affected by reduced water supply.

- For Putah South Canal, alfalfa and pasture were selected based on the crop mix in the Solano Irrigation District (DWR 2010)
- For Zone 7, vines and pistachios were selected as crops identified as receiving SWP water (Zone 7 UWMP 2020)

Crop applied water requirements were obtained from DWR (2010) for the Vacaville and Livermore DAUs (Detailed Analysis Units)

Effects of Water Supply Changes on Crop Acreage

Effects on crop acreage were calculated as changes in water supply (AF), divided by crop water requirement (AF/Acre), and times crop acreage proportion (DWR 2010):

For example, *pistachios in the 35 scenario*:

Pistachios: 325 AF reduction / (2.73 AF/Acre) * 4.19% of acres = 5 acres potentially fallowed

Vines: 325 AF reduction / (1.05 AF/Acre) * 95.81% of acres = 295 acres potentially fallowed

Estimated Economic Effects of Water Supply Changes

- SWAP Model inputs for Region 9 were used to estimate gross and net revenues for the selected crops to best emulate the SWAP modeling process.
- The reduction in agricultural water supply for each flow scenario was proportionally allocated to the selected crops within each region (Putah South Canal and Zone 7) and divided by the Applied Water Requirement for each crop to estimate the reduction in crop acres.
- The reduction in crop acres was multiplied by the gross and net revenues ($/acre) shown in the table below to estimate the total change in gross and net revenues by flow scenario.

Region	Crops	Gross Revenue	Net Revenue
Zone 7	Pistachios	$5,217	$599
	Vine	$6,696	$1,184
Putah South Canal	Alfalfa	$1,858	$485
	Pasture	$926	$420

Change in Gross and Net Revenues, Average Year

Scenario	Change in Gross Revenue	Change in Net Revenue
35	-$4,756,326	-$1,211,029
45	-$11,751,865	-$2,606,496
55	-$19,093,797	-$4,128,994
65	-$22,925,263	-$4,976,514
75	-$25,420,151	-$5,554,589

Change in Gross and Net Revenues, Dry Year

Scenario	Change in Gross Revenue	Change in Net Revenue
35	-$6,647,574	-$1,712,921
45	-$15,055,046	-$3,370,788
55	-$20,703,191	-$4,460,097
65	-$24,567,314	-$5,361,228
75	-$26,790,689	-$5,889,353

References Consulted

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- Zone 7 Water Agency. 2021. 2020 Urban Water Management Plan. Final Report. Prepared by West Yost. June 2021.

Section 2: Central Coast

Sacramento/Delta Water Supply to Central Coast

- Water that is exported from the Sacramento/Delta to the Central Coast is accounted for in SacWAM as CVP and SWP exports.
- CVP water for agriculture is delivered to the North Central Coast (San Felipe Unit) via the Pacheco Conduit ("San Felipe Ag Demand" SacWAM Node) to two CVP contractors (ag portion; note that M&I share is in SF Bay Area):

  Santa Clara Valley WD

  San Benito County WD

- SWP water is delivered to South Central Coast via the Coastal Aqueduct (portion of "Central Coast/Tulare" SacWAM Node) to two SWP contractors:

  San Luis Obispo County FC&WCD: No SWP deliveries to agriculture (San Luis Obispo IRWMP 2014)

  Santa Barbara County FC&WCD: Deliveries of SWP water to 11 cities and water districts in Santa Barbara County, of which five water districts use a portion of their SWP supplies for agricultural irrigation (Santa Barbara IRWMP 2013).

- According to the Santa Barbara County IRWMP, SWP water is commingled with Cachuma Project water in Lake Cachuma. Information from the IRWMP was used to determine the share of SWP water supply to agriculture in the five water districts.

- Findings and required analyses:

  CASRAA analysis conducted of San Felipe Unit water use.

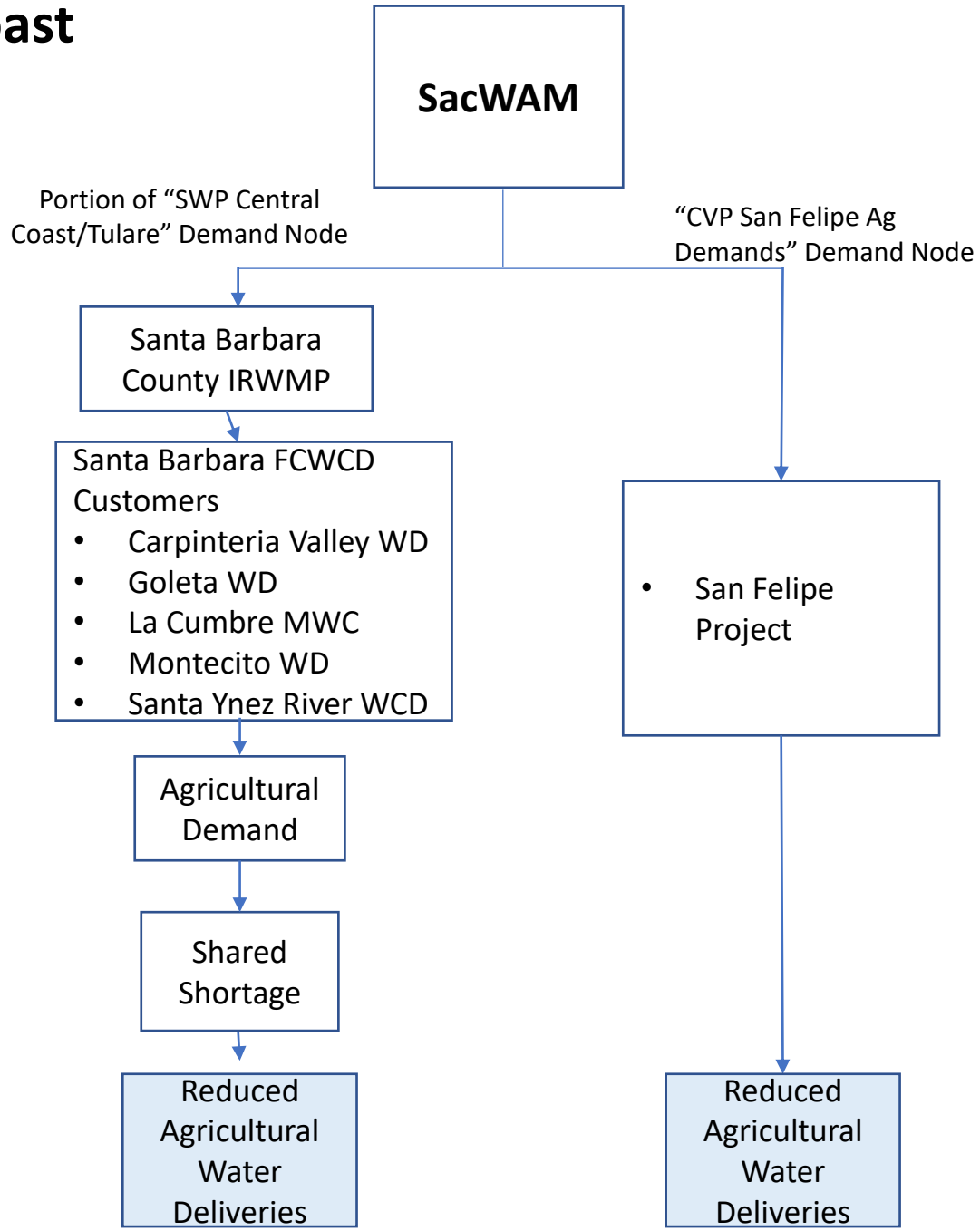
  CASRAA analysis conducted on Santa Barbara County FC&WCD water use.

Central Coast

Step 1: SacWAM output is apportioned to SWP/CVP water users in the Central Coast. San Felipe Project CVP agricultural deliveries are provided through San Luis Reservoir (Pacheco Conduit). Santa Barbara County SWP deliveries are provided through Central Coast Aqueduct and commingled with Cachuma Project supplies.

Step 2: Reviewed Santa Barbara County IRWMP to identify any estimated agricultural demands that receive water from the Sac/Delta.

Step 3: Estimate the reduction in agricultural water supply for each UF scenario assuming a shared shortage between agricultural and M&I water users.



Central Coast - North

Estimated Reduction in Agricultural Water Deliveries:

CVP San Felipe Project agricultural water deliveries (from SacWAM).

Deliveries to CVP San Felipe Ag Deliveries as Estimated by SacWAM (AF) for Node "CVP San Felipe Ag Demands"

Scenario	Avg	Dry
Baseline	36,666	25,830
35	36,122	25,180
45	34,311	21,971
55	29,559	14,974
65	16,690	7,443
75	12,710	3,102

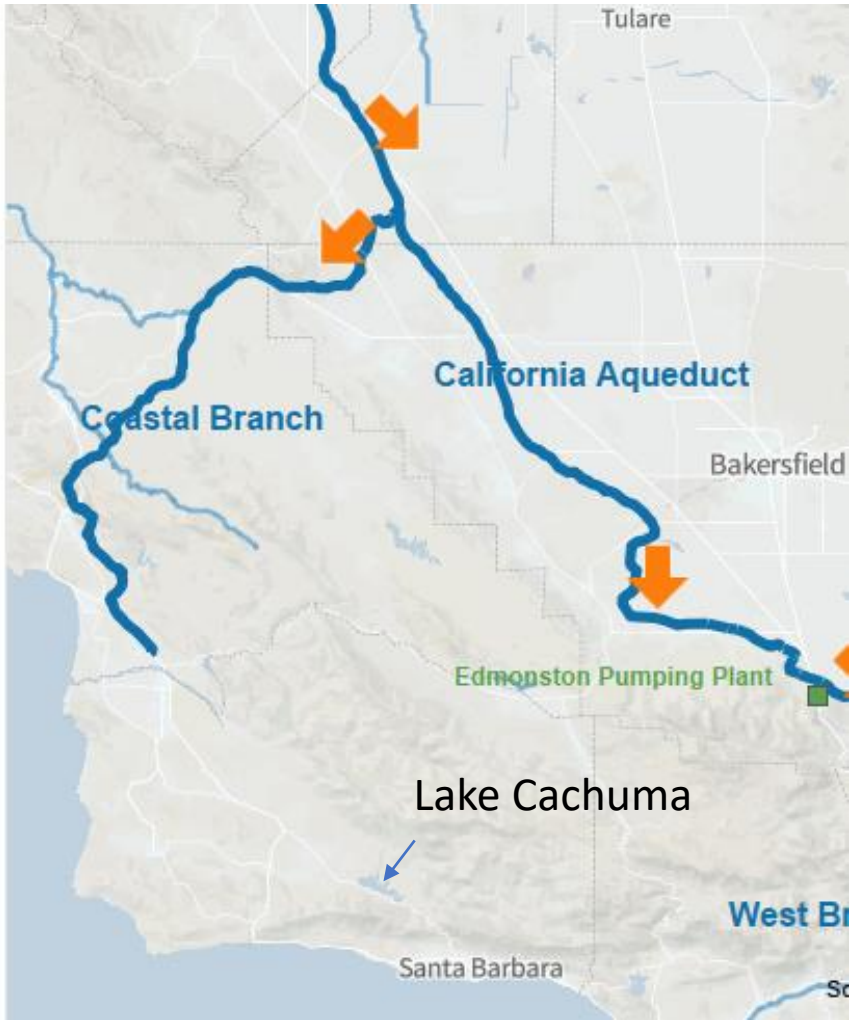
Change in CVP San Felipe Project agricultural water deliveries (from SacWAM).

Scenario	Average	Dry
35	-544	-650
45	-2,355	-3,859
55	-7,107	-10,856
65	-19,975	-18,387
75	-23,956	-22,728

Central Coast, South – SWP Coastal Branch and Lake Cachuma

- Coastal Branch originates at California Aqueduct in Kings County, then traverses San Luis Obispo County and Santa Maria Valley.
- The aqueduct then connects to the Santa Ynez Extension pipeline, which extends southeast and terminates in Lake Cachuma, a USBR project. Lake Cachuma stores both local and SWP water.
- USBR Cachuma Project: 184,000 AF storage reservoir with a 25,714 AF annual yield

  Project provides about 85% of the municipal water to 250,000 residents plus supplemental irrigation for 12,000 acres
- Facilities connected to Lake Cachuma then transport stored water (Cachuma Project and SWP) south to coastal Santa Barbara County communities and water districts.



Central Coast – South, SWP Deliveries to SBCFCWD

Total SacWAM deliveries to Central Coast/Tulare demand site.

Santa Barbara County FCWCD's proportion of total Table A contracts among supply delivered by Central Coast/Tulare Demand Node (3.78%)

Total reductions in SWP deliveries to Santa Barbara County FCWCD were obtained from SacWAM output using Santa Barbara County FCWCD's share of Table A deliveries to Central Coast/Tulare.

Proportional reduction in Table A deliveries to Central Coast/Tulare Demand Node by UF Scenario. Obtained by dividing the change in total Santa Barbara County deliveries for UF scenarios by the Base delivery volume (see table 1).

Change in Total Central Coast/Tulare SWP Deliveries (AF) as Estimated by SacWAM for SWP Central Coast/Tulare Demand Site

UF Scenario	Avg	Dry
Base	782,653	619,349
35	691,460	518,559
45	626,387	468,369
55	534,691	379,466
65	436,951	278,777
75	355,325	203,042

SB County share of Central Coast Tulare =3.78%

Reduction in Santa Barbara County SWP Deliveries (AF)

UF Scenario	Avg	Dry
Base	29,584	23,411
35	3,447	3,810
45	5,907	5,707
55	9,373	9,068
65	13,068	12,874
75	16,153	15,736

Percent Reduction in Central Coast/Tulare Table A Deliveries

UF Scenario	Avg	Dry
35	11.65%	16.27%
45	19.97%	24.38%
55	31.68%	38.73%
65	44.17%	54.99%
75	54.60%	67.22%

Central Coast – South, Continued

The IRWMP for Santa Barbara County was used to identify agricultural water use. We identified five water providers that deliver water to agriculture. Total ag water demand from all sources for the five water providers is 7,026 AF.

The IRWMP does not provide a breakdown of ag and M&I water use by water source. The SWP percentage of total water supply for each water provider was obtained by dividing the IRWMP-reported SWP deliveries by the IRWMP-reported total water deliveries for each water provider.

The estimated SWP ag water use was estimated by multiplying the total ag demand for each provider (first table) by the percent reliance on SWP supplies (second table) and then summed over the five water providers (586 AF).

Apply the percent reduction in SWP supplies from SacWAM (last table on previous slide) to the SWP ag water use (586 AF) to estimate the change in agricultural water supplies by UF scenario.

Estimated Santa Barbara County Total Ag Water Use (AF) for Water Providers Receiving SWP

Water Provider	Ag Demand (AF)
Carpinteria Valley Water District	1,582
Goleta Water District	2,387
La Cumbre Mutual Water Company	103
Montecito Water District	550
Santa Ynez River WCD, ID #1	2,404
Total	**7,026**

SWP Percentage of Total Water Supply for Each Water Provider

Water Provider	% SWP Supply
Carpinteria Valley Water District	10%
Goleta Water District	7%
La Cumbre Mutual Water Company	21%
Montecito Water District	10%
Santa Ynez River WCD, ID #1	8%

Estimated SWP Ag Water Use = 586 AF

Change in Santa Barbara County Ag Deliveries (AF)

UF Scenario	Avg	Dry
35	30	47
45	91	120
55	163	181
65	227	223
75	309	271

Crops and Effects of Water Supply Changes on Crop Acreage

- Representative Crops and Crop Water Requirement
  - San Felipe Unit:

Selected Crops	Percent	Applied Water (AF/Acre)
Sweet Cherries	6.67%	2.04
Organic Lettuce	11.20%	0.94
Fresh Tomatoes	7.86%	1.32
Bell Peppers	21.53%	0.94
Proc. Tomatoes	22.62%	1.70
Wine Grapes	30.13%	0.92

  - Santa Barbara County:

Selected Crops	Percent	Applied Water (AF/Acre)
Avocados	19%	2.52
Wine Grapes	56%	1.04
Lettuce	10%	1.52
Strawberries	15%	1.52

Average Year

	35	45	55	65	75
Vegetables	-300	-1,000	-3,000	-8,200	-9,800
Deciduous Orchards	0	-100	-300	-700	-800
Processing Tomatoes	-100	-300	-900	-2,700	-3,200
Vine	-200	-800	-2,400	-6,600	-8,000
Alfalfa & Pasture	0	0	0	0	0
Corn and All Silage	0	0	0	0	0
Wheat & Field Crops	0	0	0	0	0
Almonds & Pistachios	0	0	0	0	0
Cotton	0	0	0	0	0
Rice	0	0	0	0	0
TOTAL	-500	-2,200	-6,500	-18,200	-21,800

Dry Year

	35	45	55	65	75
Vegetables	-300	-1,600	-4,500	-7,600	-9,300
Deciduous Orchards	0	-200	-400	-600	-800
Processing Tomatoes	-100	-500	-1,400	-2,400	-3,000
Vine	-200	-1,300	-3,600	-6,100	-7,600
Alfalfa & Pasture	0	0	0	0	0
Corn and All Silage	0	0	0	0	0
Wheat & Field Crops	0	0	0	0	0
Almonds & Pistachios	0	0	0	0	0
Cotton	0	0	0	0	0
Rice	0	0	0	0	0
TOTAL	-600	-3,600	-9,900	-16,700	-20,700

Estimated Economic Effects of Water Supply Changes

- Published crop budgets from the University of California were used to estimate gross and net revenues for the selected crops.
- The reduction in agricultural water supply for each flow scenario was proportionally allocated to the selected crops within each region (San Felipe Unit and Santa Barbara County) and divided by the Applied Water Requirement for each crop to estimate the reduction in crop acres.
- The reduction in crop acres was multiplied by the gross and net revenues ($/acre) shown in the table below to estimate the total change in gross and net revenues by flow scenario.

Region	Crops	Gross Revenue	Net Revenue
San Felipe Unit	Sweet Cherries	$22,156	$2,933
	Organic Lettuce	$14,977	$2,910
	Fresh Tomatoes	$8,782	$763
	Bell Peppers	$26,359	$9,317
	Proc. Tomatoes	$5,144	$2,096
	Wine Grapes	$26,689	$5,532
Santa Barbara County	Avocados	$10,791	$1,124
	Wine Grapes	$20,048	$5,503
	Lettuce	$11,250	$2,383
	Strawberries	$54,785	$8,467

Change in Gross and Net Revenues ($), Average Year

Scenario	Change in Gross Revenue	Change in Net Revenue
35	-$10,748,650	-$2,680,824
45	-$45,642,715	-$11,454,356
55	-$135,131,057	-$34,120,264
65	-$374,335,766	-$94,961,173
75	-$449,791,651	-$114,031,896

Change in Gross and Net Revenues ($), Dry Year

Scenario	Change in Gross Revenue	Change in Net Revenue
35	-$13,116,409	-$3,250,030
45	-$74,109,302	-$18,652,522
55	-$204,792,575	-$51,840,184
65	-$344,893,319	-$87,465,401
75	-$426,209,749	-$108,096,715

References Consulted

- California Department of Water Resources (DWR). 2010. Land and Water Use Estimates. Available: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Agricultural-Land-And-Water-Use-Estimates. Accessed: September 20, 2017.
- Santa Clara Valley Water District. 2021. *2020 Urban Water Management Plan*. June 2021.
- San Benito County Water District. 2021. *2020 Hollister Urban Area Urban Water Management Plan*. Final. Prepared by Todd Groundwater for San Benito County Water District, Sunnyslope County Water District, and City of Hollister. July 2021.San Luis Obispo County FC&WCD. 2014. "Integrated Resource Water Management Plan, Appendix D."
- San Luis Obispo County Flood Control and Water Conservation District. 2014. *Integrated Regional Water Management Plan, Section D. Water Supply, Demand, and Water Budget*. July 2014.
- Santa Barbara County FC&WCD. 2013. "Integrated Resource Water Management Plan 2013, Chapter 3." Prepared by RMC, Dudek, and GEI.
- University of California Cooperative Extension, 2013. Costs and Profitability Analysis for Bell Pepper Production, Oxnard Plain, Ventura County, Fresh Bell Pepper Production.
- University of California Cooperative Extension, 2011. Sample Costs to Establish an Orchard and Produce Sweet Cherries, San Joaquin Valley, North.

References Consulted (continued)

- University of California Cooperative Extension, 2009. Sample Costs to Produce Organic Leaf Lettuce, Central Coast Region, Santa Cruz & Monterey Counties.
- University of California Cooperative Extension, 2007. Sample Costs to Produce Fresh Market Tomatoes, San Joaquin Valley.
- University of California Cooperative Extension, 2007. Sample Costs to Produce Processing Tomatoes, Sacramento Valley.
- University of California Cooperative Extension, 2012. Sample Costs to Establish and Produce Winegrapes, Cabernet Sauvignon, North Coast Region, Napa County.
- University of California Cooperative Extension, 2011. Avocado Sample Establishment and Production Costs and Profitability Analysis for Ventura, Santa Barbara, and San Luis Obispo Counties, 2011. Conventional Production Practices.
- University of California Cooperative Extension, 2009. Sample Costs to Produce Organic Leaf Lettuce, Central Coast Region, Santa Cruz & Monterey Counties.
- University of California Cooperative Extension, 2010. Sample Costs to Produce Strawberries, Central Coast Region, Santa Cruz & Monterey Counties.
- University of California Cooperative Extension, 2012. Sample Costs to Establish and Produce Winegrapes, Cabernet Sauvignon, North Coast Region, Napa County.

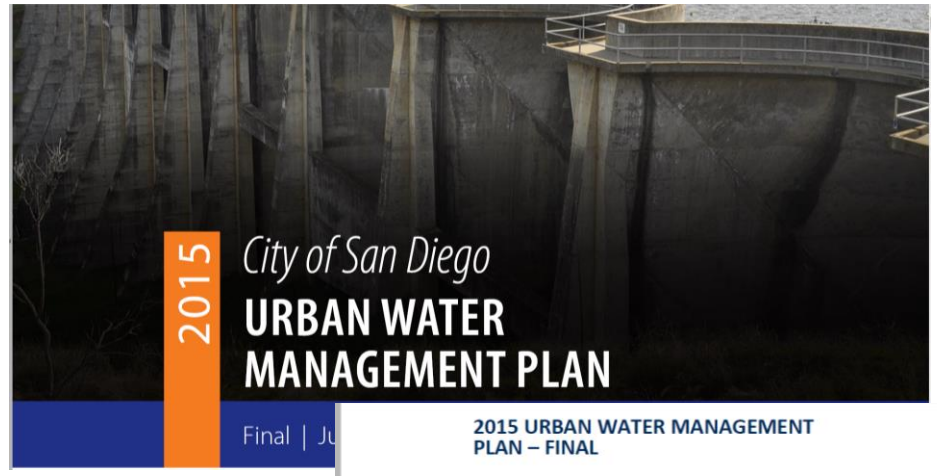
Section 3: Southern California

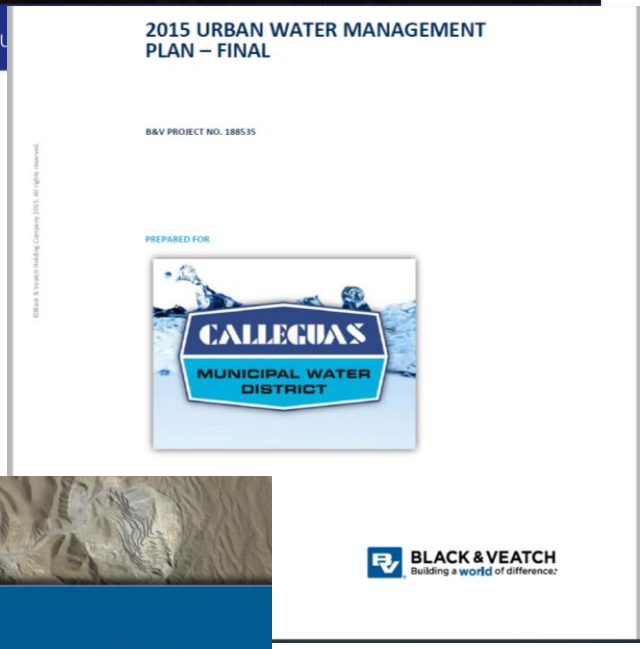
Sacramento/Delta Water Supply to Southern California

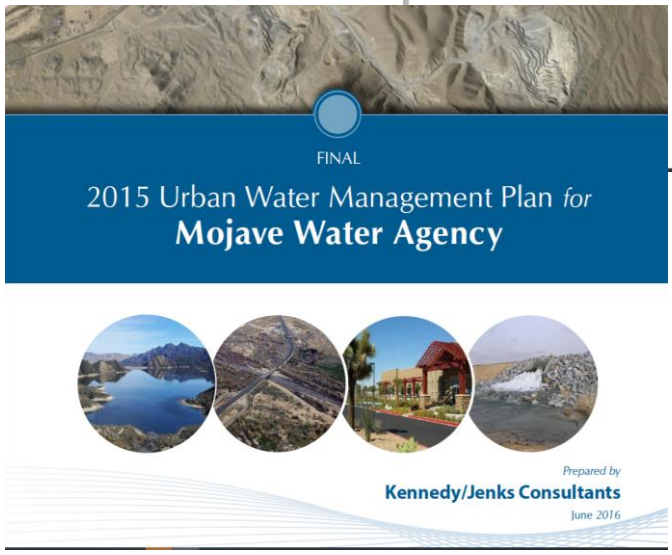
- Water that is exported from the Sacramento/Delta to Southern California arrives via the State Water Project (SWP) to 12 contractors
- All 12 contractors deliver water primarily, or exclusively, for municipal purposes. Some contractors deliver water that is ultimately used by agricultural producers.
- All 12 contractors receive water from multiple sources.
- Local water management plans, including UWMPs were reviewed to develop reasonable assumptions to estimate the amount of Sacramento/Delta supply that is used for agricultural irrigation.
- This presentation provides an analysis of how Sacramento/Delta water supply for agricultural irrigation is estimated, and how water supply changes to Southern California could affect agricultural producers.

Southern California Agricultural Water Demand

1. Identify the water providers in the Southern California Region that receive water from the SWP. This includes MWD member agencies and SWP contractors.
2. Analyzed spatial data for cropping (2014 DWR data) and water agency boundaries to focus research efforts.
3. Reviewed Urban Water Management Plans (UWMPs) to identify projected 2030 agricultural water demands for each agency.
4. Only considered agricultural water use that is not identified in the UWMPs as being supplied from local sources (groundwater, recycled water, etc.).







SWP Contractor Water Use (Part 1 of 2)

- Agencies with no deliveries for agricultural irrigation
  - Crestline – Lake Arrowhead
  - Desert Water Agency
  - Palmdale Water District
  - San Gorgonio Pass Water Agency
- Agencies with no SWP deliveries to agriculture
  - Coachella Valley Water District
    - Only Colorado River deliveries to ag
  - Littlerock Creek Irrigation District
- Agencies with minimal agricultural irrigation sales
  - Antelope Valley – East Kern Water Agency
    - 330 of 85,940 AFY
  - Mojave Water Agency
  - San Bernardino Valley Municipal Water District
    - 387 of 82,520 AFY
  - San Gabriel Valley Municipal WC
    - 32 AFY of recycled water,
    - 46,403 AFY total

SWP Contractor Water Use (Part 2 of 2)

- Agency with agricultural irrigation deliveries
  - Metropolitan Water District
    - Wholesale water agency with 26 member agencies (cities, regional districts, and local wholesalers)
    - Member agencies that provide water for agricultural irrigation:
      - Calleguas Municipal Water Agency
      - Eastern Municipal Water District
      - San Diego County Water Agency
      - Western Municipal Water District
- Other SWP Contractors
  - Castaic Lake Water Agency
    - Accounted for in SWAP through exchange in SJV; no irrigation in service area
  - Ventura County Flood Control District (now Watershed Protection District)
    - Administered by Casitas MWD, allocated 5,000 AF to United WCD, w/ 3,150 AF for recharge

Southern California Agricultural Water Supply Effects – General Approach With Focus on Four MWD Member Agencies

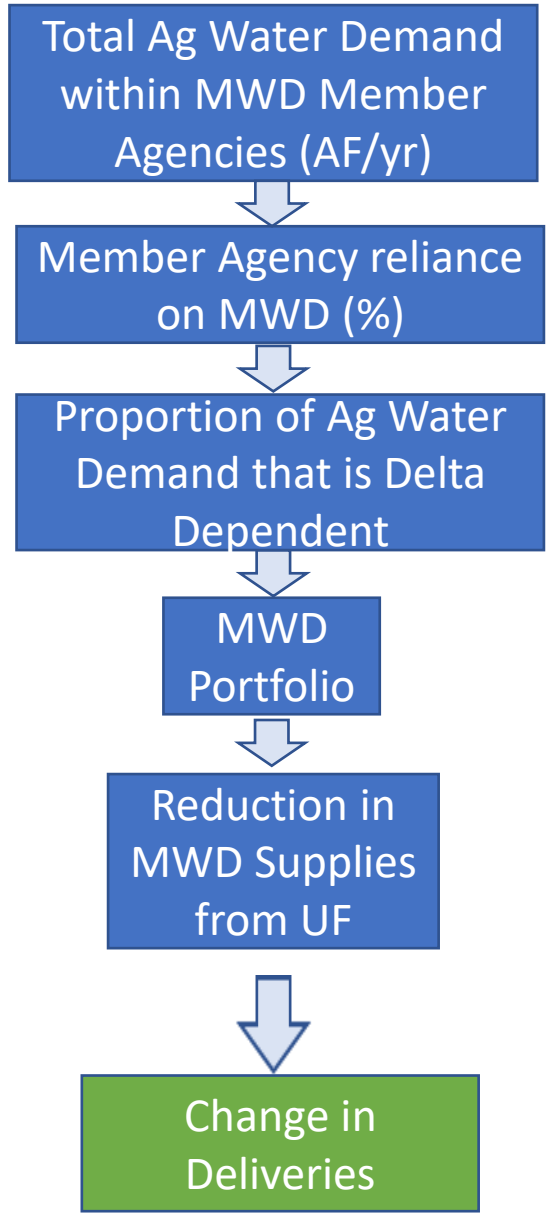
Step 1: Review UWMPs for MWD Member Agencies to identify agricultural water demand from raw or treated surface water supplies (excluding groundwater and recycled water)

Step 2: Review UWMPs for MWD Member Agencies to identify reliance upon MWD imported water. Typically estimated as: MWD Supply/Total Water Supply = % from MWD

Step 3: Identify the proportion of agricultural water supplied to Member Agencies by MWD that is Delta dependent.

Step 4: Apply SacWAM output to estimate the reduction in MWD's SWP water supplies for each UF scenario. Assume Ag Demand is reduced proportional to reduced water delivery

Step 5: Estimate the reduction in agricultural water supply



Step 1: Southern California Agricultural Water Demands From Review of References Consulted

Water Provider	Agricultural Demand (AF)
SDCWA	49,897
Calleguas	4,848
Eastern Municipal	2,900
Western Municipal	11,358
Total	**69,003**

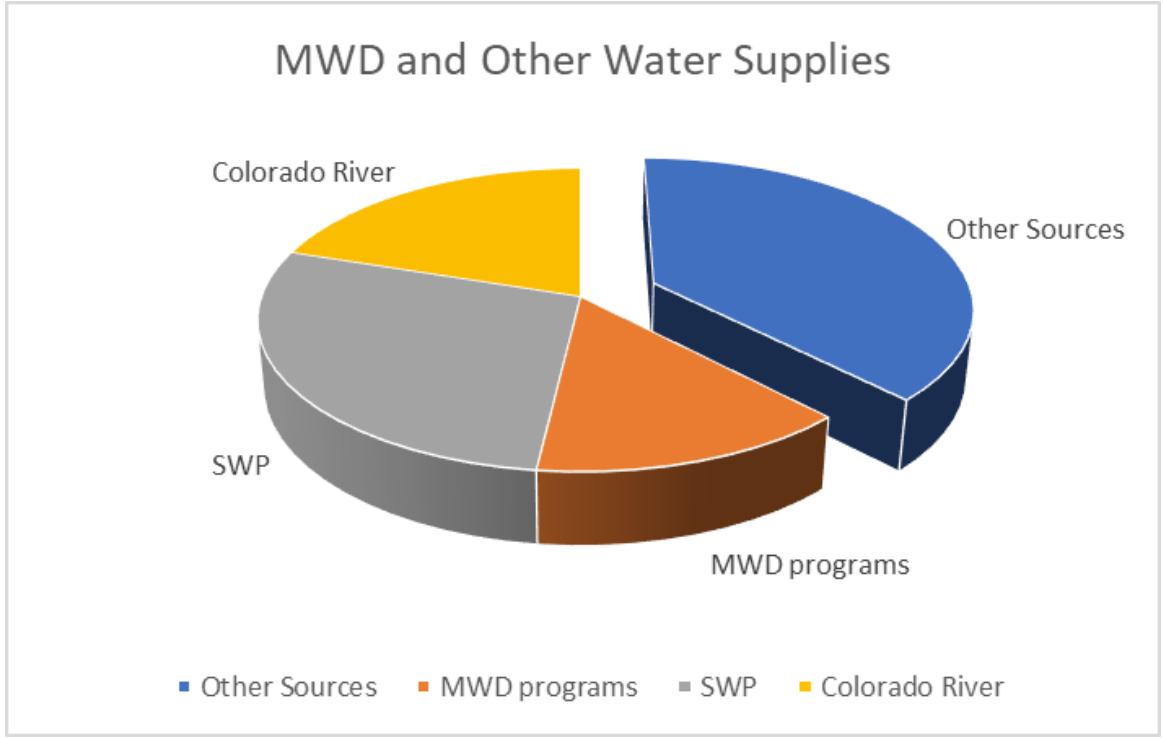
Step 2: Identify Member Agency dependence on imported water provided by MWD

1. Reviewed Urban Water Management Plans (UWMPs) to identify projected 2030 water supplies, and the proportion that is purchased from MWD.
2. Multiplied the percentage that is supplied from MWD by the total agricultural water demand for each agency to estimate the agricultural water supplied by MWD.

Water Provider	Total Ag Demand (AF)	Percent from MWD	Max Ag Supply From MWD (AF)
SDCWA	49,897	30.65%	15,293
Calleguas	4,848	100.00%	4,848
Eastern Municipal	2,900	92.78%	2,691
Western Municipal	11,358	82.98%	9,425
Total	**69,003**		**32,257**

MWD Managed Supplies Projected Water Portfolio in 2030
Based on MWD UWMP (2020)

- Projected Demands on MWD in 2030:
  1,388,000 AFY
- Projected MWD Supply in 2030:
  - In-Region MWD Supplies and Programs:
    - 877,000 AFY (22.5% of total)
  - State Water Project, representing MWD's water supply projection:
    - 1,766,000 AFY (45.4% of total)
  - Colorado River
    - 1,250,000 AFY (32.1% of total)
  - TOTAL SUPPLY: 3,893,000 AFY
- MWD receives more water than it delivers to customers. Projected surplus in 2030: 2,505,000 AFY
- Water from supply sources are commingled by MWD before delivery to customers. Customers do not control percent of supply that is Sac/Delta. MWD's UWMPs do not provide information on the composition of the water delivered to customers.



Step 3: Identify the proportion of imported MWD agricultural water supply that is dependent on Sacramento/Delta supplies.

1. Reviewed MWD Integrated Water Resource Management Plan to identify projected 2030 SWP water supplies.
2. Divided 2030 SWP water supplies by the total 2030 MWD imported water supply to estimate the proportion of imported MWD agricultural water supply that is Delta dependent – **45.4%**.
3. Applied the MWD SWP % to the Max Ag Water Supply from MWD to develop an estimate of the agricultural water demand potentially affected by the UFs.

Water Provider	Total Ag Demand (AF)	Percent from MWD	Max Ag Supply From MWD (AF)	MWD Sac/Delta %	Ag Sac/Delta Supply from MWD
SDCWA	49,897	30.65%	15,293	45.4%	6,938
Calleguas	4,848	100.00%	4,848	45.4%	2,199
Eastern Municipal	2,900	92.78%	2,691	45.4%	1,221
Western Municipal	11,358	82.98%	9,425	45.4%	4,275
Total	**69,003**		**32,257**		**14,633**

Step 4: Apply SacWAM output to estimate the overall reduction in MWD's SWP supplies for each UF scenario

The CASRAA analysis estimates the reductions in water supply to MWD using SacWAM output. To estimate the change in agricultural water supply, the percent reduction in MWD's SWP supply is applied.

MWD's SWP Supply (AF)

UF Scenario	Average	Dry
Baseline	1,224,891	842,612
35 Scenario	1,157,370	755,143
45 Scenario	1,052,417	626,241
55 Scenario	898,704	502,595
65 Scenario	747,156	395,976
75 Scenario	554,336	275,647

Volume Reduction in MWD's SWP Supply (AF)

UF Scenario	Average	Dry
Baseline	1,224,891	842,612
35 Scenario	67,521	87,469
45 Scenario	172,475	216,371
55 Scenario	326,187	340,017
65 Scenario	477,735	446,636
75 Scenario	670,555	566,965

Percent Reduction in MWD's SWP Supply (%)

UF Scenario	Average	Dry
35 Scenario	5.51%	10.38%
45 Scenario	14.08%	25.68%
55 Scenario	26.63%	40.35%
65 Scenario	39.00%	53.01%
75 Scenario	54.74%	67.29%

Step 5: Estimate the reduction in agricultural water supply for each UF scenario assuming that shortages are shared equally by agricultural customers and other municipal uses.

Multiply the percent reduction in water supply to MWD from the UFs by the Ag Delta Supply from MWD.

Ag Delta Supply from MWD (AF)
14,633

UF Scenario	Average	Dry
35 Scenario	5.51%	10.38%
45 Scenario	14.08%	25.68%
55 Scenario	26.63%	40.35%
65 Scenario	39.00%	53.01%
75 Scenario	54.74%	67.29%

(From previous slide)

UF Scenario	Average	Dry
Baseline	14,500	9,974
35 Scenario	13,700	8,939
45 Scenario	12,458	7,413
55 Scenario	10,638	5,949
65 Scenario	8,844	4,687
75 Scenario	6,562	3,263

UF Scenario	Average	Dry
35 Scenario	799	1,035
45 Scenario	2,042	2,561
55 Scenario	3,861	4,025
65 Scenario	5,655	5,287
75 Scenario	7,938	6,711

Crops and Effects of Water Supply Changes on Crop Acreage

- Representative Crops and Crop Water Requirement (DWR 2010)
- Applied to crops in proportion to existing DAU acreage (DWR 2010):
  - Ventura County (DAU 081)
  - Riverside North (DAU 098)
  - Riverside South (DAU 104)
  - Temecula (DAU 110)
  - San Diego County (DAU 120)

	Acre-Feet / Acre
Lemons	3.09
Avocadoes	3.09

Average Year

	35	45	55	65	75
Lemons	-49	-126	-239	-350	-491
Avocados	-212	-541	-1,024	-1,499	-2,104

Dry Year

	35	45	55	65	75
Lemons	-64	-159	-249	-327	-415
Avocados	-274	-679	-1,067	-1,402	-1,779

Estimated Economic Effects of Water Supply Changes

- Published crop budgets from the University of California were used to estimate gross and net revenues for the selected crops.
- The reduction in agricultural water supply for each flow scenario was proportionally allocated to the selected crops and divided by the Applied Water Requirement for each crop to estimate the reduction in crop acres.
- The reduction in crop acres was multiplied by the gross and net revenues ($/acre) shown in the table below to estimate the total change in gross and net revenues by flow scenario.

Crops	Gross Revenue	Net Revenue
Lemons	$22,713	$4,295
Avocados	$16,622	$629

Change in Gross and Net Revenues ($), Average Year

Scenario	Change in Gross Revenue	Change in Net Revenue
35	-$4,645,780	-$425,857
45	-$11,867,044	-$1,087,796
55	-$22,443,159	-$2,057,259
65	-$32,870,380	-$3,013,073
75	-$46,137,280	-$4,229,187

Change in Gross and Net Revenues ($), Dry Year

Scenario	Change in Gross Revenue	Change in Net Revenue
35	-$1,455,782	-$276,371
45	-$14,887,311	-$683,657
55	-$23,394,740	-$1,074,336
65	-$30,730,627	-$1,411,215
75	-$39,009,802	-$1,791,412

Urban Water Management Plans (UWMPs) Consulted

- Metropolitan Water District of Southern California. 2021. *2020 Urban Water Management Plan*. June 2021.
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Section 4: Upper Watersheds
(Upper Sacramento River Watershed & Upper Delta Eastside Tributaries)

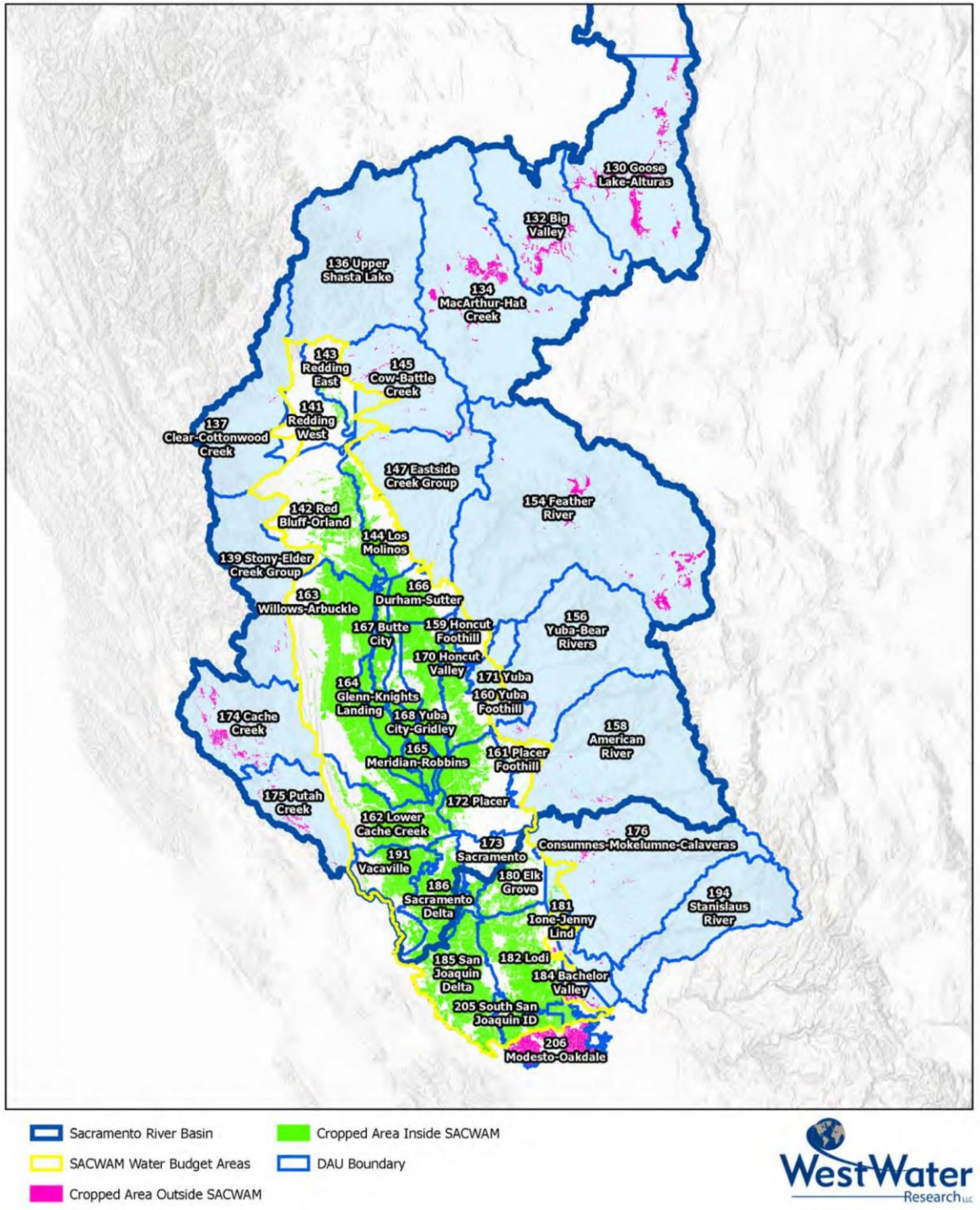
Upper Watersheds Slides

- The potential effects of the flow scenarios on agricultural production in the Upper Watersheds is dependent upon the relative priorities of surface water rights in the Upper Watersheds and Sacramento Valley, and the estimated effects of reduced water supply.

- These slides provide baseline information on crop types and crop acreage in the Upper Watersheds to inform qualitative analyses of the potential effects of the flow scenarios on agriculture and economics in the region.

Upper Watersheds Irrigated Agriculture

- The figure at right shows the irrigated crop areas within the SacWAM model region (green) and outside of the SacWAM model region (pink).
- A majority of the irrigated area in the Upper Sacramento Watershed is located within Cache Creek, Putah Creek, Feather River, and above Shasta Lake as represented by DWR's DAU boundaries.
- Cropped areas rely upon a mix of surface water and groundwater supplies.
- Cropped areas within Cache and Putah creeks are primarily planted to wine grapes. Other upper watershed cropped areas include a diverse crop mix but are primarily planted to alfalfa, pasture, and grains according to DWR 2010 land use survey data.
- Stoney Creek DAU irrigation is relatively small (less than 4 thousand acres) and mostly consists of pasture.



Upper Watersheds

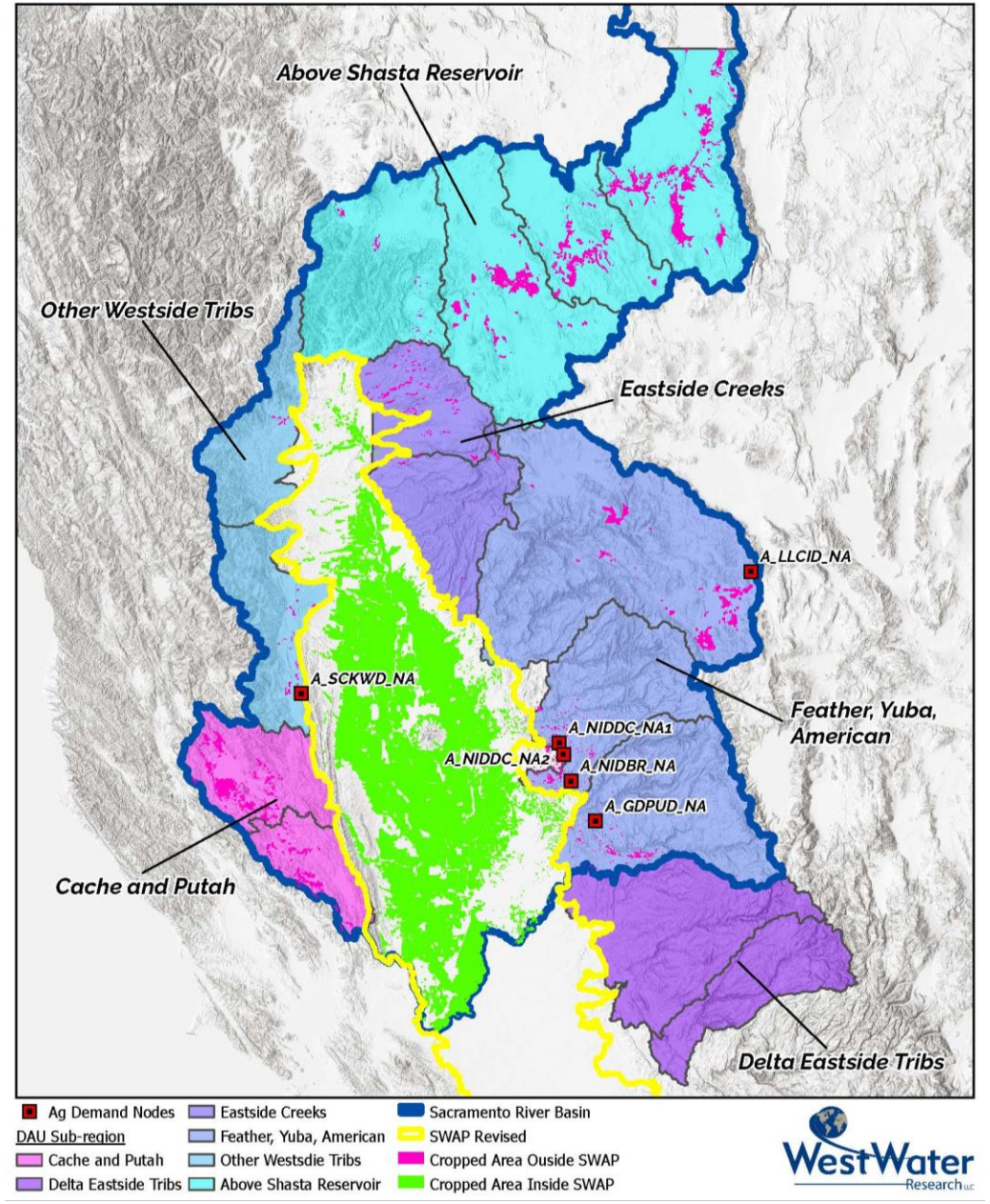
- The table at right lists the DWR DAUs included in the CASRAA analysis organized by analysis region.
- Included all Detailed Analysis Units (DAUs) outside of the SacWAM/SWAP model area and in the Sacramento Basin. Also included Delta Eastside tribs (Consumnes, Mokelumne, Calaveras, Stanislaus).
- The selection of analysis regions is based upon the extent of irrigation, crop types, and the proportion of surface water versus groundwater use.
- Subarea include:
  - Cache and Putah DAUs
  - Other Westside Tribs
  - Above Shasta Lake
  - Eastside Creeks
  - Feather, Yuba, American
  - Delta Eastside Tribs

DWR DAUs by Subarea

Subarea	DAU Name	DAU Number
Cache and Putah	Cache Creek	174
	Putah Creek	175
Other Westside Tribs	Stony-Elder Creek Group	139
	Clear-Cottonwood Creek	137
Above Shasta Reservoir	Upper Shasta Lake	136
	MacArthur Hat Creek	134
	Big Valley	132
	Goose Lake-Alturas	130
Eastside Creeks	Cow-Battle Creek	145
	Eastside Creek Group	147
Feather, Yuba, American	Feather River	154
	Yuba-Bear	156
	American River	158
Delta Eastside Tribs	Consumnes-Mokelumne-Calaveras	176
	Stanislaus River	194

Upper Watersheds

Subarea	DAUs	Irrigated Acres	Notes
Cache-Putah	174, 175	22,045	Contains the largest proportion of high-valued wine grape acreage, potentially largest economic effect
Other Westside Tribs	137, 139	3,052	Small acreage, nearly all irrigated pasture
Above Shasta Reservoir	130, 132, 134, 136	130,852	Largest subarea in terms of irrigated acreage; half is pasture, most of the remainder alfalfa and grain
Eastside Creeks	145, 147	10,561	Nearly all (96%) in irrigated pasture
Feather-Yuba-American	154, 156, 158	70,142	Second largest subarea in acreage, half in pasture, most of the remainder alfalfa and grain
Upper Delta Eastside Tribs	176, 194	9,037	Mix of wine grapes (60%), pasture (32%) and other crops
	Total	**245,689**	



Upper Watersheds Irrigated Agriculture – Analysis Subareas

- Cache and Putah: Wine grapes is the primary crop (64% of total acres).
- Other Westside Tribs: Primarily pasture (74% of total acres).
- Above Shasta Reservoir: Primarily pasture, alfalfa, and grains (91%).
- Eastside Creeks: Primarily pasture (96%).
- Feather, Yuba, American: Primarily pasture, alfalfa, and grains (95%)
- Delta Eastside Tribs: Primarily wine grapes (60%)

Crop Acres by Subarea and DAU

Subarea	DAU Name	DAU Number	Irrigated Area (Acres)
Cache and Putah	Cache Creek	174	15,895.0
	Putah Creek	175	6,150.0
	Total		**22,045.0**
Other Westside Tribs	Stony-Elder Creek Group	139	2,461.0
	Clear-Cottonwood Creek	137	591.0
	Total		**3,052.0**
Above Shasta Reservoir	Upper Shasta Lake	136	2,720.0
	MacArthur Hat Creek	134	40,967.0
	Big Valley	132	33,906.0
	Goose Lake-Alturas	130	53,259.0
	Total		**130,852.0**
Eastside Creeks	Cow-Battle Creek	145	9,838.0
	Eastside Creek Group	147	723.0
	Total		**10,561.0**
Feather, Yuba, American	Feather River	154	61,675.0
	Yuba-Bear	156	4,661.0
	American River	158	3,806.0
	Total		**70,142.0**
Delta Eastside Tribs	Consumnes-Mokelumne-Calaveras	176	6,626.0
	Stanislaus River	194	2,411.0
	Total		**9,037.0**
	Grand Total		**245,689.0**

Upper Watersheds

DWR land survey data from 2010 was used to estimate the total agricultural water demand.

Irrigated Crop Acres by Subarea

Crop Category	Cache and Putah	Other Westside Tribs	Above Shasta Reservoir	Eastside Creeks	Feather, Yuba, American	Delta Eastside Tribs	Total
Grain	369	0	20,711	0	9,117	0	**30,197.0**
Rice	986	0	8,528	0	0	0	**9,514.0**
Cotton	0	0	0	0	0	0	**0.0**
Sgrbeet	0	0	0	0	0	0	**0.0**
Corn	13	0	0	12	1	0	**26.0**
DryBean	6	0	0	0	0	0	**6.0**
Safflwr	0	0	0	0	0	0	**0.0**
Oth Fld	0	0	940	0	0	0	**940.0**
Alfalfa	84	152	23,666	2	8,143	0	**32,047.0**
Pasture	2,612	2,269	75,284	10,115	49,645	2,850	**142,775.0**
Pr Tom	0	0	0	0	0	0	**0.0**
Fr Tom	0	0	0	0	0	0	**0.0**
Cucurb	2	0	0	0	0	0	**2.0**
On Gar	1	0	254	0	0	0	**255.0**
Potato	0	0	0	0	0	0	**0.0**
Oth Trk	52	13	1,345	46	557	130	**2,143.0**
Al Pist	13	50	0	13	0	0	**76.0**
Oth Dec	3,869	301	124	117	1,230	603	**6,244.0**
Subtrop	32	264	0	2	136	8	**442.0**
Vine	14,006	3	0	254	1,313	5,446	**21,022.0**
Total	**22,045.0**	**3,052.0**	**130,852.0**	**10,561.0**	**70,142.0**	**9,037.0**	**245,689.0**

Upper Watersheds

Total crop acres by category (shown on the previous slide) were multiplied by the average applied water requirement by crop category shown in the table to the right to estimate total agricultural water demand.

Average Crop Applied Water Requirements (AF/acre)

Crop Category	Cache and Putah	Other Westside Tribs	Above Shasta Reservoir	Eastside Creeks	Feather, Yuba, American	Delta Eastside Tribs
Grain	0.4	0.0	1.2	0.0	2.7	0.0
Rice	5.4	0.0	4.7	0.0	0.0	0.0
Cotton	0.0	0.0	0.0	0.0	0.0	0.0
Sgrbeet	0.0	0.0	0.0	0.0	0.0	0.0
Corn	2.9	0.0	0.0	1.9	3.3	0.0
DryBean	2.2	0.0	0.0	0.0	0.0	0.0
Safflwr	0.0	0.0	0.0	0.0	0.0	0.0
Oth Fld	0.0	0.0	1.6	0.0	0.0	0.0
Alfalfa	4.6	4.0	2.8	3.5	2.7	0.0
Pasture	4.7	4.0	3.0	2.7	3.2	3.5
Pr Tom	0.0	0.0	0.0	0.0	0.0	0.0
Fr Tom	0.0	0.0	0.0	0.0	0.0	0.0
Cucurb	0.8	0.0	0.0	0.0	0.0	0.0
On Gar	1.9	0.0	2.6	0.0	0.0	0.0
Potato	0.0	0.0	0.0	0.0	0.0	0.0
Oth Trk	2.5	2.0	1.7	1.7	1.1	1.1
Al Pist	3.6	3.2	0.0	2.3	0.0	0.0
Oth Dec	3.3	2.7	1.6	2.3	1.9	2.6
Subtrop	2.7	2.2	0.0	1.7	2.0	1.4
Vine	1.8	1.7	0.0	1.5	0.7	0.6

The total estimated agricultural water demand for all regions is approximately 684 TAF. Highest water demands in Above Shasta Reservoir and Feather, Yuba, American subareas.

Estimated Annual Total Agricultural Water Demand (AF)

Subarea	Volume (AF)
Cache and Putah	56,129
Other Westside Tribs	11,334
Above Shasta Reservoir	365,532
Eastside Creeks	28,137
Feather, Yuba, American	207,796
Delta Eastside Tribs	15,026
Total	**683,953**

Upper Watersheds

The total estimated agricultural water demand (repeated from prior slide).

Estimated Total Agricultural Water Demand

Subarea	Volume (AF)
Cache and Putah	56,129
Other Westside Tribs	11,334
Above Shasta Reservoir	365,532
Eastside Creeks	28,137
Feather, Yuba, American	207,796
Delta Eastside Tribs	15,026
Total	**683,953**

Total surface water demand was estimated by multiplying the percentage of surface water use for irrigation by the total agricultural water demand. USGS 2010 county-level water use estimates were used to estimate the surface water use percentages. County level estimates were apportioned based upon the overlap of county and DAU boundaries.

Estimated Irrigation Water Source (%)

Subarea	Groundwater (%)	Surface Water (%)
Cache and Putah	43%	57%
Other Westside Tribs	40%	60%
Above Shasta Reservoir	28%	72%
Eastside Creeks	49%	51%
Feather, Yuba, American	29%	71%
Delta Eastside Tribs	28%	72%

The total estimated agricultural surface water demand is approximately 477 TAF.

Estimated Surface Water Demand (AF)

Subarea	Volume (AF)
Cache and Putah	32,058
Other Westside Tribs	6,841
Above Shasta Reservoir	264,877
Eastside Creeks	14,462
Feather, Yuba, American	147,665
Delta Eastside Tribs	10,816
Total	**476,720**

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